

ZH -> e e + b b

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## The plan for this analysis

1. Repeat Z+inclusive and Z+2jets cross sections for baseline
2. Upgrade our version of Athena to include the certified JLIP b tagger and latest d0correct – data and MC
2. Expand to forward region  $|\text{electron eta}| < 2.5$  and include all Pass 2 data
3. Measure Z+b jet cross section
4. Compare Z+b/Z+j measurements
5. Measure Z+2b jet cross section (limit)
6. Look at ZH cross section limit

# Repeating the Z+inclusive in MC

	Marcs avg eff	My avg eff	Marcs parameterized eff	My parameterized eff
Eff reco	97.93	97.93	98.04	98.41
Eff reco*id	93.11	93.11	93.59	93.71
Eff track	87.5	87.91		
Z pT				
Acceptance	21.4	21.3		
MC Closure	Initial 183	Initial 183	Final 179	Final 180

# Repeating Z+X and Z+2 jets in Data

EM1TRK - need to use for efficiencies

2EM High Pt – has certified JLIP

	Inclusive	1 Jet	2 Jets
EM1TRK	13892	1647	219
2EM High Pt	13893	1646	219

	Marcs avg eff	My avg eff	Marcs parameterized eff	My parameterized eff
Eff reco*ID	88.9	87.9	Unkown	87.8
Eff track	77.1	76.5		
Eff trigger <v12	94.6	94.6		
Eff trigger v12	98.2	98.2		
Cross section	Inclusive 249	Inclusive 251	Z+2 jets 4.50	Z+2 jets 4.56

# Expanding out to $|\eta| < 2.5$ for electrons

Three topologies

CC-CC  $|\eta_{\text{det}}| < 1.1$

CC-EC  $|\eta_{\text{det}}| < 1.1$  and 2<sup>nd</sup> object -  $|\eta_{\text{det}}| > 1.5$  and  $|\eta_{\text{det}}| < 2.5$

EC-CC 1<sup>st</sup> object -  $|\eta_{\text{det}}| > 1.5$  and  $|\eta_{\text{det}}| < 2.5$  2<sup>nd</sup> object -  $|\eta_{\text{det}}| < 1.1$

Require at least 1 track match

EC electrons use  $\text{Hmatrix8} < 20.0$

Recalculate Eff\_reco, Eff\_reco\*ID, Eff\_track, Zpt, Acceptance

Still under investigation:

using the likelihood cut and loosening Hmatrix7 - **bug in D0correct / Athena**  
shrinking the requirement of the primary vertex  $< 60\text{cm}$  to boost tracking eff

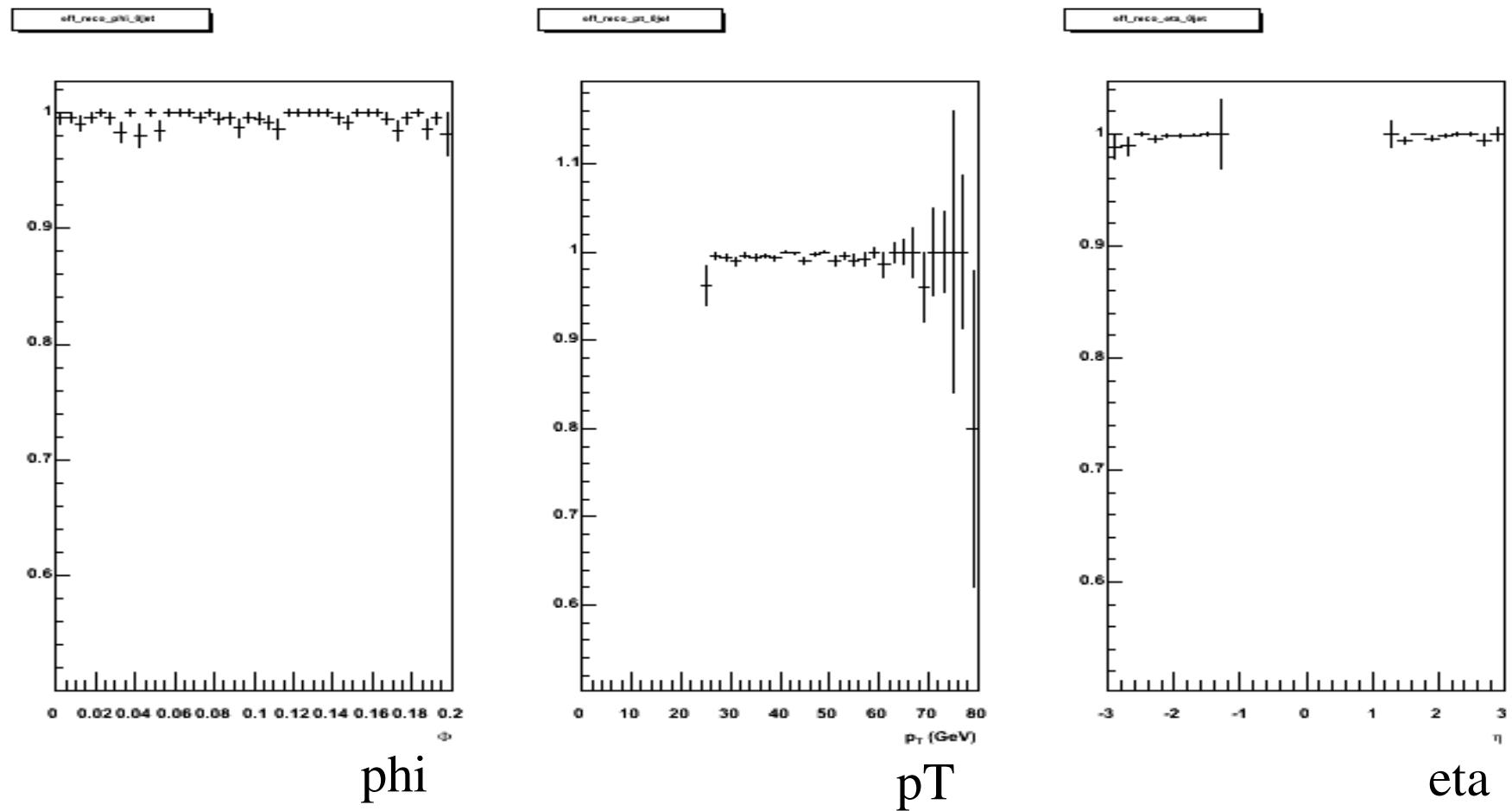
**showing today**

loosening the Hmatrix7 cut based on jet multiplicity – **showing today**

# MC EM Reco Efficiency

For Reco and Reco\*ID the CC electron efficiencies remain the same.

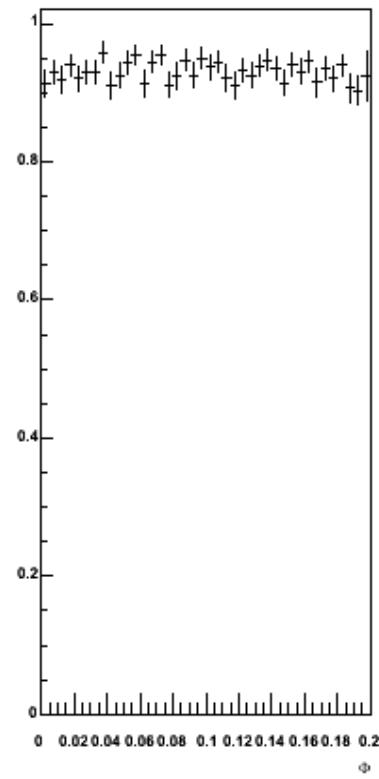
The EC efficiencies have no phi dependance, are flat in eta, and only have a pT dependence.



# MC EM Reco\*ID

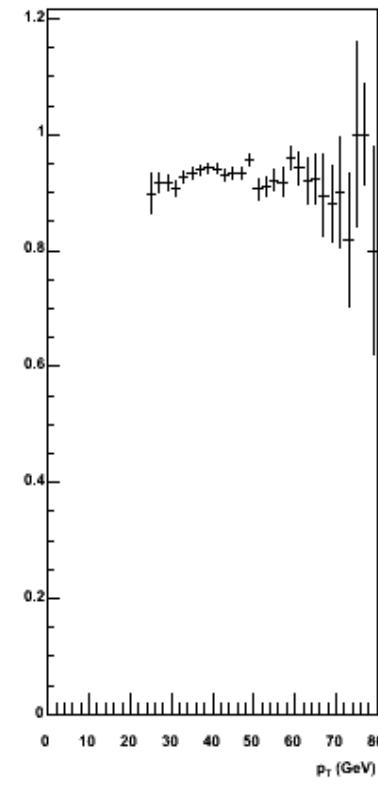
EC has no phi dependence, but asymmetry in the eta dependence

aH\_EM\_phi\_0jet



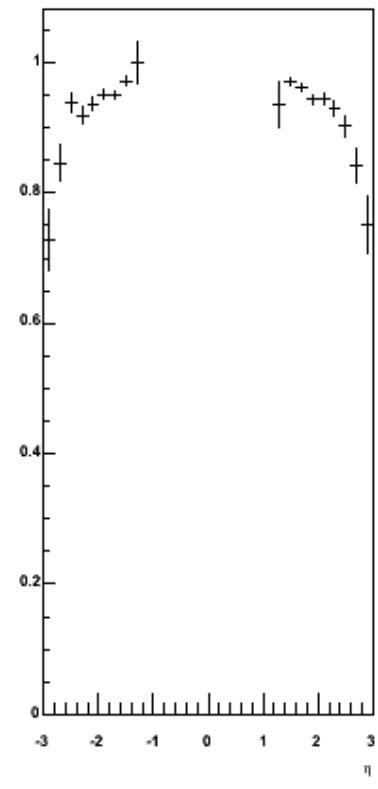
phi

aH\_EM\_pt\_0jet



pT

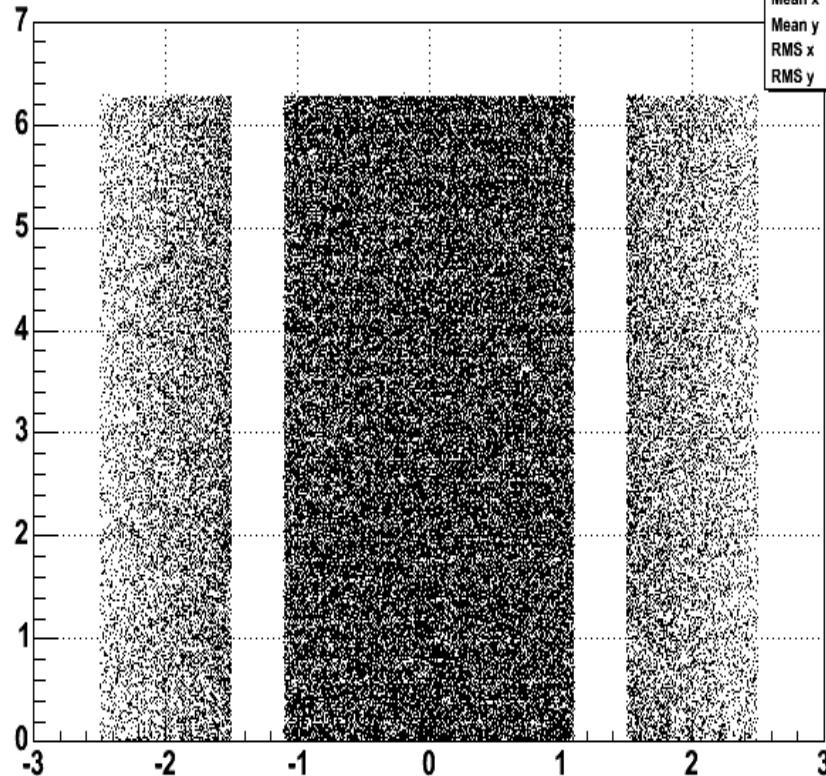
aH\_EM\_eta\_0jet



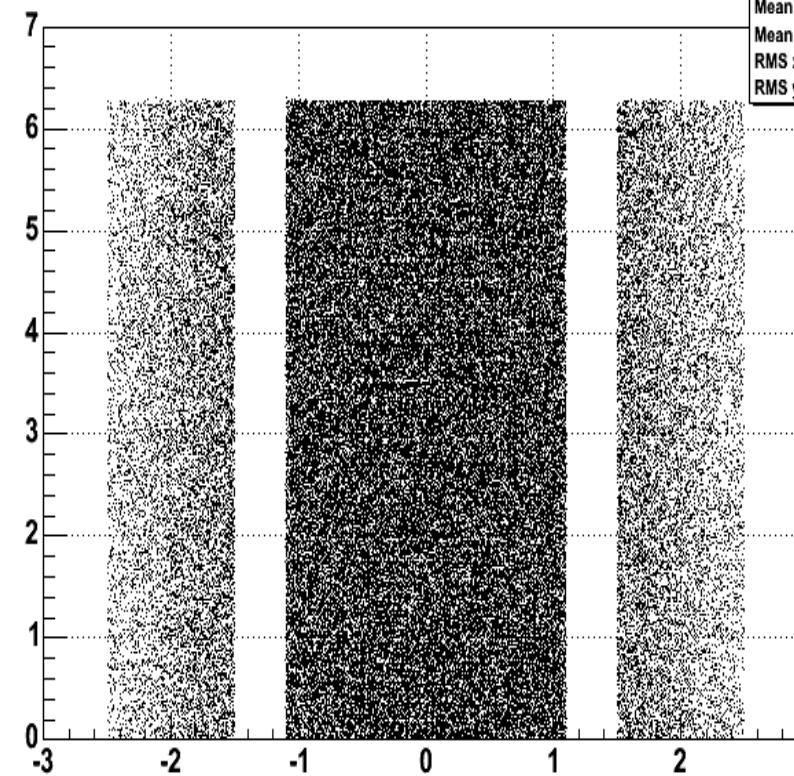
eta

# EM eta,phi, pT distributions

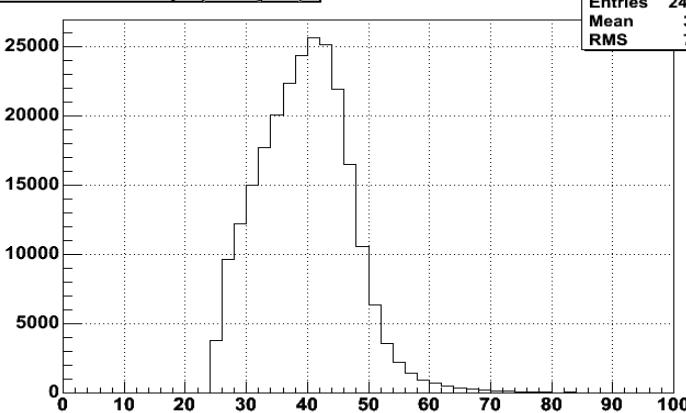
1st elec deteta vs detphi\_0jet (1trk)



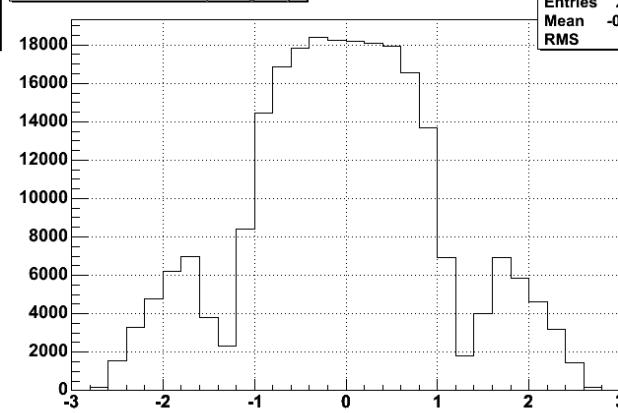
2nd elec deteta vs detphi\_0jet (1trk)



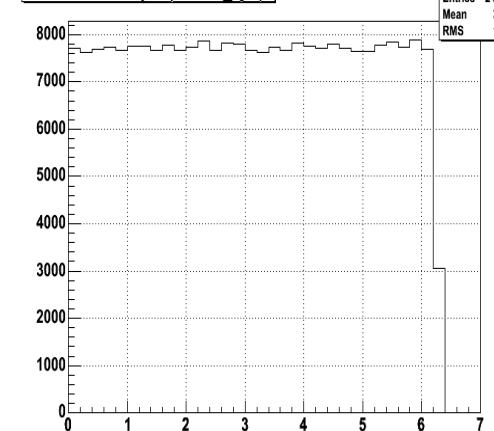
1st & 2nd elec pt ( $\geq 0$  jets)



1st & 2nd elec eta ( $\geq 0$  jets)



1st & 2nd elec phi (1 track\_0jet)



# MC Closure

	$ \eta  < 1.1$ avg	Average	Parameterized
Eff Reco	97.93	98.33	98.55
Eff Reco*ID	93.11	93.5	93.69
Eff track	87.91	86.7	
Acceptance	21.3	37.8	
Cross section	Initial 183	Final 181	

# Hmx7 Tag and Probe

Idea – maybe we can loosen the Hmx7 at higher jet multiplicities.

Tag is EM object passing all reco\*id, trigger (all steps), and has a track match.

Reco\*ID  $pT > 25.0$   $\text{iso} < 0.15$   $\text{Hmx7} < 12$   $\text{emf} > 0.90$   $\text{deteta} \leq 1.1$

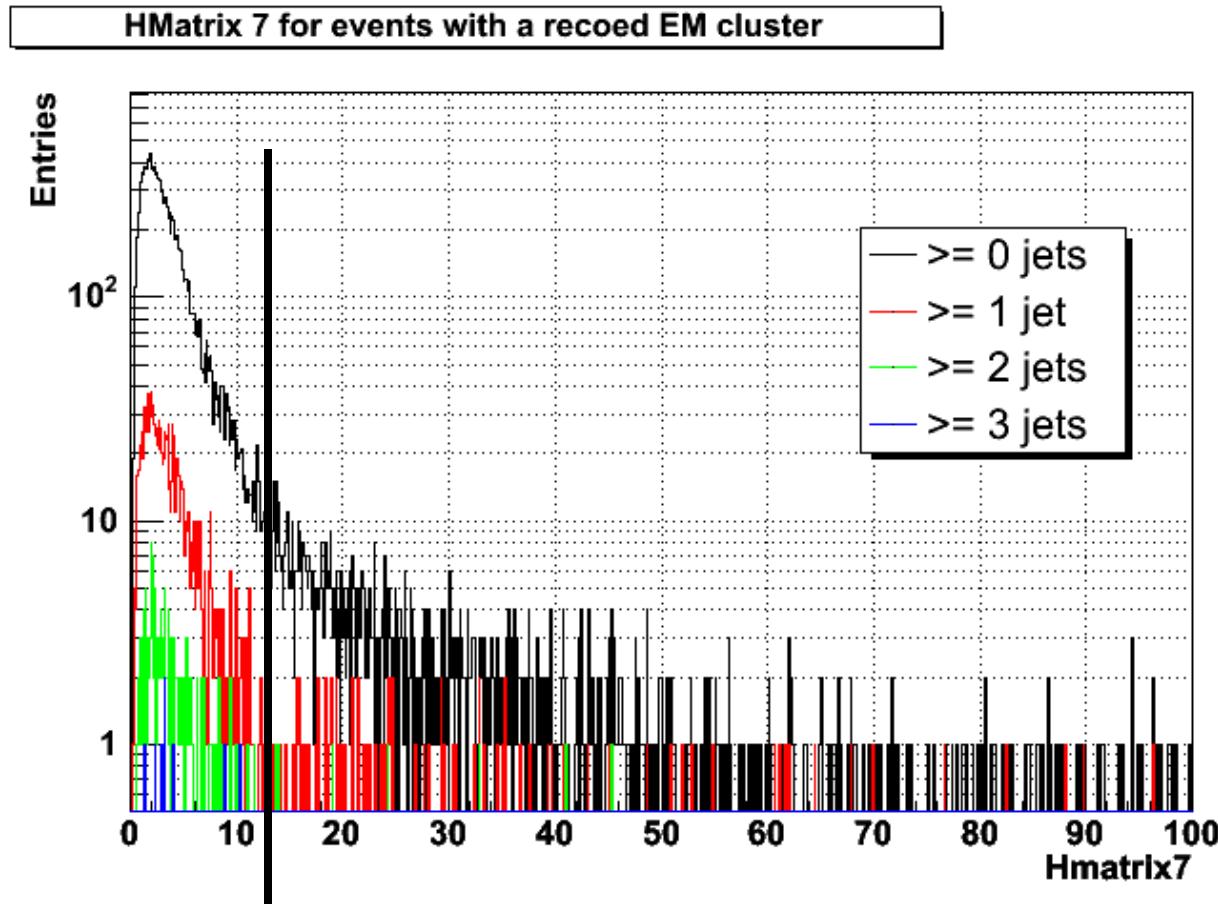
Trigger – single high pT 20-30 GeV at Level 3

Track –  $25 < pT < 80$   $\text{chi2} < 8$   $\text{dca,xy} < 0.3\text{cm}$   $\text{dca,z} < 4\text{cm}$   $\text{deteta} \leq 1.1$

Probe track – as defined above, opposite sign, invariant mass window  $70 < \text{Mem-trk} < 110$ , and  $\text{MeT} < 15.0$

If Recoed EM cluster was found within  $\Delta R < 0.14$  then plot Hmx7

# Hmatrix7 vs Jet Multiplicity



current cut < 12

# Tracking Efficiency vs Detector Eta for different cuts on the primary vertex

Tag the same as before

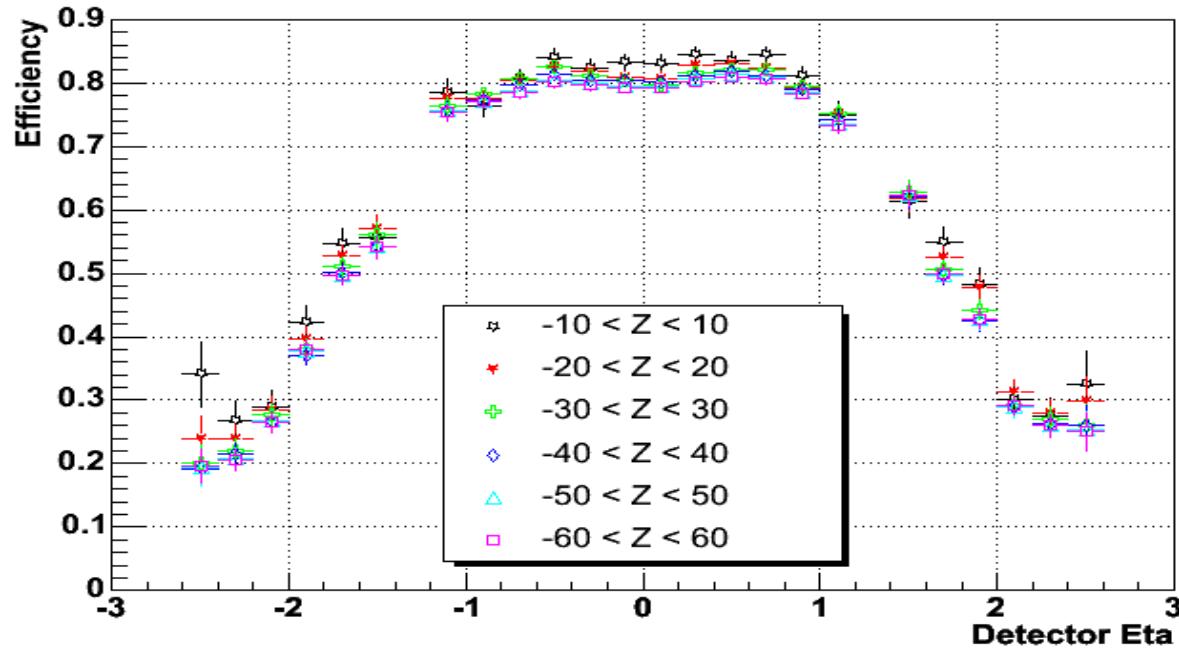
Probe – Recoed EM object passing all ID cuts

$\text{pt} > 25$ ,  $\text{emf} > 0.90$ ,  $\text{iso} < 0.15$ ,  $\text{hmx7} < 12$ . CC  
 $\text{hmx8} < 20$ . EC

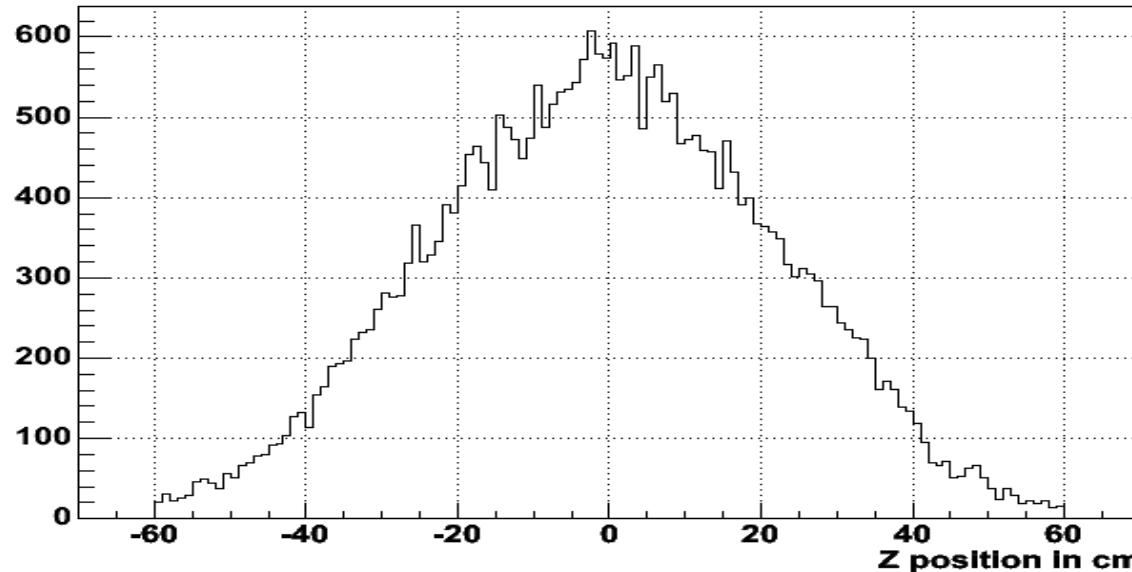
Invariant mass window  $75 < \text{Mee} < 105$  and  $\text{MeT} < 15$

# Narrowing the Primary Vertex

Tracking Efficiency vs Detector Eta



Primary Vertex



# Conclusion

1. Repeat Z+inclusive and Z+2jets cross sections for baseline
2. Upgrade our version of Athena to include the certified JLIP b tagger and latest d0correct – data and MC
2. Expand to forward region  $|\text{electron eta}| < 2.5$  and include all Pass 2 data
3. Finalize electron selection criteria
4. Measure Z+b jet cross section
5. Compare Z+b/Z+j measurements
6. Measure Z+2b jet cross section (limit)
7. Look at ZH cross section limit